

## Two new species of the genus *Oreophryne* from Irian Jaya, Indonesia

(Amphibia, Anura, Microhylidae)

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Two new species of *Oreophryne* from western Irian Jaya (Papua Barat = West Papua) are described. They are small (SVL of males < 24 mm) and distinguished from all congeners by having prominent, angular snouts and dark brown or black head sides and throats. Both taxa are scansorial, calling from leaves between about 0.5 m and 2.5 m above the ground in rainforest habitats. The advertisement calls of both species consist of long trains of distinctly pulsed notes, but calls differ from one another in several structural features including the number of pulses per note.

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### Introduction

The most recent overviews of New Guinea amphibians recognise 14 species of the microhylid genus *Oreophryne* from mainland New Guinea and surrounding islands (Frost 1985, 1998-1999, Zweifel & Tyler 1982). Since those summaries only one additional species, the extremely small *O. minuta*, has been described from the region (Richards & Iskandar 2000). However recent surveys in Indonesian New Guinea (Irian Jaya) by S. Richards and D. Iskandar, and independently by R. Günther, have revealed a number of new *Oreophryne* species. Two of these, one from the Wondiwoi Mountains at the base of the Wandammen Peninsula, and the other from the Wapoga River basin, appear to be very closely related to one another but distinct from all previously described *Oreophryne*. Here we describe the new species and present brief observations on their advertisement calls and natural history.

### Material and methods

Frogs were generally collected at night when they were easily detected by their distinctive advertisement calls. Several individuals of both new species were photographed in life and all specimens were anaesthetised with chlorobutanol and fixed in 2 % formalin (RG) or 70 % ethanol (SJR, DI). Tissue samples were extracted from some specimens and stored in 70 % ethanol before the animals were fixed in formalin, to allow later DNA studies. All specimens were preserved in 75% ethanol upon return to the laboratory.

Advertisement calls were recorded with a Sony Walkman TCD-D100 Digital Audio Tape (DAT) and Sennheiser microphone MKE 300 (RG) or a Sony WMD-6C Professional Walkman and ECM-Z 200 microphone (SJR). Calls were analyzed with Avisoft-SAS Lab software. Two paratypes of the new species from Wandammen Peninsula were cleared and stained using a method modified from Dingerkus & Uhler (1977). Snout-urostyle length (SUL), tibia length (TL), length of 4th toe (L4T) and length of 3rd toe (L3T) – from tip of the toes to proximal end of inner metatarsal tubercle, tarsus length (TaL), and distance between the supratympanic folds immediately behind eyes (FD), were measured with a vernier calliper; length of the first toe (L1T) from tip to distal end of inner metatarsal tubercle, length of the inner metatarsal tubercle (LMT), horizontal diameter of the disc of the 4th toe (T4D) and that of the 3rd finger (F3D), head length from tip of snout to posterior margin of tympanum (HL), head width taken in the ear region (HW), distance from anterior corner of orbital opening to center of naris (END), internarial distance between the centres of the nares (IND), distance from anterior to posterior corner of orbital opening (ED), and horizontal diameter of tympanum (TyD) were measured with an ocular micrometer in a binocular dissecting microscope.

Type specimens are deposited in the Museum für Naturkunde, Berlin (ZMB), the South Australian Museum, Adelaide (SAMA) and the Museum Zoologicum Bogoriense, Bogor (MZB).

Photographs in Figs 14 and 15 were taken by S. Richards, all others by R. Günther.

### *Oreophryne atrigularis*, spec. nov.

Figs 1-13

**Types.** **Holotype:** ZMB 62226, adult male, collected by R. Günther on 30.VII.1998 at an altitude of 610 m a.s.l., Wondiwai Mountains at the base of the Wandammen Peninsula, about 8 km west of the coastal village of Yeretuar, 2°56'S, 134°36'E, Nabire district, Irian Jaya, Indonesia. – **Paratypes:** 22 adult males with inventory numbers ZMB 62162, 62164-67, 62182, 62215, 62217-20, 62222-25, 62641-42 and 62644-45, MZB. Amph. 7361-62 and SAMA R55924; one adult and one subadult female (ZMB 62640 and 62163); and two juvenile specimens ZMB 62216 and 62646. Two adult males (ZMB 63291 and 63292), were cleared and double stained as skeletal preparations and are stored in glycerine. All paratypes were collected between 350-750 m a.s.l. on the eastern slopes of the Wondiwai Mountains west of the coastal village of Yeretuar, ZMB 62214-26 between 28.VII-1.VIII.1998, ZMB 62162-66, 62182 between 21.-29.VIII.1999 and ZMB 62167, 62640-46 between 7.-12.V.2000. Collectors were R. Günther, S. Marani, G. Mareku and I. Tetzlaff.

**Diagnosis.** *O. atrigularis* is assigned to the genus *Oreophryne* on the basis of the structure of its shoulder girdle: clavicles and procoracoids are present but reduced. The former are small ossified bones which are broadly separated and reach laterally only to the middle of the coracoids. The cartilaginous procoracoids nearly meet the anterior tip of the sternum, and extend laterally no further than the middle of the coracoids. A combination of the following characters separates the new species from all hitherto known congeners: (1) snout strongly protruding and canthus rostralis sharply edged, (2) throat and sides of head black, (3) no webbing between toes, (4) fifth toe shorter than third toe. Advertisement call a long series of notes, each between 171 and 262 milliseconds in length.

### Description of the holotype

An adult male with the following measurements (in mm) and ratios: SUL 22.0, TL 11.7, L4T 9.9, L3T 7.2, FD 6.7, TaL 7.2, L1T 1.7, LMT 1.0, T4D 1.0, F3D 1.1, HL 6.8, HW 8.3, END 2.0, IND 2.1, ED 2.4, TyD 0.8; TL/SUL 0.53, HL/SUL 0.309, HW/SUL 0.377, END/SUL 0.091, ED/SUL 0.109, HL/HW 0.819 and F3D/SUL 0.050. Skin smooth, snout tapering and projecting, canthus rostralis sharply defined; no maxillary or vomerine teeth; two palatal ridges, anterior ridge very low and with indistinct lobes, posterior ridge with 14 small but distinct whitish denticles; tongue elongated, without indentation and free posteriorly; one rather long slit-like vocal sac opening on each side of the tongue, with a single internal subgular vocal sac. Loreal region straight and angled outwards; tympanum covered by skin and scarcely visible. Head broader than long; legs rather long and slender, all fingers and toes expanded distally into discs with circummarginal grooves, discs on fingers somewhat broader than those on toes, terminal disc of 3rd finger about twice as broad as penultimate phalanx, first finger and first toe conspicuously reduced. Fingers in order of decreasing length  $3 > 4 > 2 > 1$ ; toes  $4 > 3 > 5 > 2 > 1$ . Subarticular tubercles and metatarsal tubercle poorly developed. Upper side of head, dorsum and limbs beige with some spots and marbling. A conspicuous whitish mid-dorsal line is bordered by concentrations of blackish pigments along its whole length. A similar line extends from heel to middle of posterior side of tibia. A w-shaped mark in the scapular region surrounds two whitish spots. A black





Fig. 1. Lateral view of a paratype (ZMB 62167) of *Oreophryne atrigularis*, spec. nov.



Fig. 2. Ventral view of a paratype of *Oreophryne atrigularis*, spec. nov.



Fig. 3. Ventral view of the right hand (left) and the right foot (right) of a paratype (ZMB 62644) of *Oreophryne atrigularis*, spec. nov.

band from upper arm to tip of snout contrasts sharply with the beige dorsal colouration but grades into the blackish throat ventrally. Anterior of belly speckled with dark brown, posterior of abdomen cream coloured without spots. Concealed parts of hind limbs unpigmented, yellowish in preservative but reddish in life.

**Variation in the type series.** Snout-urostyle length of 22 adult males ranged from 20.2 to 22.5 mm (mean 21.5 mm, SD 0.65). One female was adult at 26.3 mm, and another female appears to be subadult at 22 mm, with oocytes in the early stages of development. Two specimens of 15.8 and 18 mm SUL respectively show no signs of sexual maturity. Selected body proportions of the type series (except juveniles and cleared and stained specimens) are listed in table 1. Most specimens beige dorsally, but some with greyish-brown ground colour in life, retained in ethanol. Shape of pupil is oval in all specimens, but colour in life varied from yellowish or silvery to brown. Margin of eyelid was white in all specimens in life. Tympana in all specimens more or less covered by skin. Dorsum of some specimens with minute dark spots (visible under magnification), but others with larger spots and areas of mottling on dorsum and extremities. Thirteen out of 27 specimens have a thin whitish mid-dorsal line extending from snout to end of urostyle, and in most specimens a similar line extends from heel onto posterior side of tibia (Fig. 1). About 50% of animals exhibit a w-shaped mark in scapular region that encompasses two whitish spots. Commonly a few small warts on dorsum and/or dorsal side of hind limbs. Concealed surfaces (while sitting) of hind limbs in nearly all specimens without dark pigment,

Tab. 1. Body proportions of the type series (n=23 males and 2 females) of *Oreophryne atrigularis*; SD=Standard deviation.

Ratio	Mean	SD	Range
TL/SUL	0.54	0.019	0.48-0.57
HL/SUL	0.30	0.010	0.28-0.32
HW/SUL	0.37	0.016	0.33-0.40
HL/HW	0.82	0.037	0.74-0.89
ED/SUL	0.110	0.005	0.098-0.120
END/SUL	0.095	0.003	0.087-0.103
F3D/SUL	0.053	0.004	0.043-0.060





Fig. 4. Cleared and double stained paratype (ZMB 63291, older specimen) of *Oreophryne atrigularis*, spec. nov. Dorsal view of the whole skeleton except distal parts of extremities.

cream coloured in fixative and reddish or red in life (Fig. 2). A black band from insertion of upper arm through lower part of tympanum to tip of snout, including eye and sides of snout, is conspicuous in all specimens. This black stripe contrasts sharply with beige colour of dorsum, but merges with blackish colour of the throat. Throat pale grey (not blackish) in only two specimens (ZMB 62640, female; ZMB 62641, male). Black colour of throat may extend to chest and anterior of belly, but generally grades posteriorly into dark brown or dark grey marbling. Some individuals with very small white spots on dark parts of venter, and some with an inconspicuous whitish cross on chest. Size and shape of toes and fingers as described for the holotype (Fig. 3). Ventral side of extremities more or less spotted. Skin smooth dorsally and ventrally in most specimens, but some with belly granular. Black coloration on throat and laterally on head is consistent among males, females and juveniles demonstrating that this coloration is not a secondary sexual character. However conspicuous black colour of head, evident in living specimens during the day and in preserved specimens as well, is more or less faded, and in some cases invisible, in specimens actively calling at night.

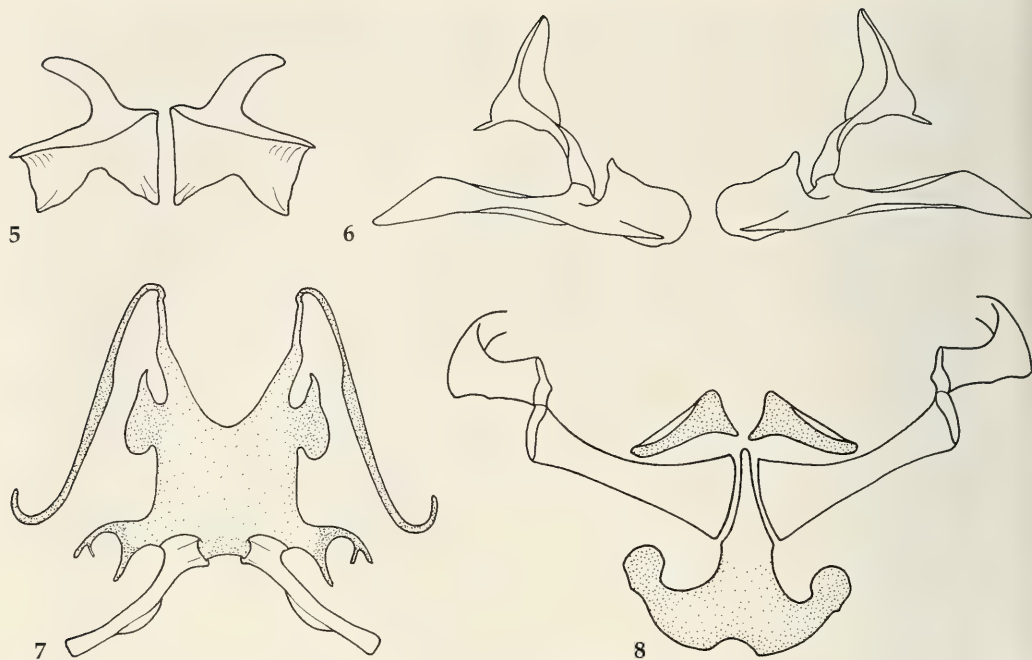


Fig. 5. Premaxillaries of *Oreophryne atrigularis*, spec. nov. (ZMB 63291).

Fig. 6. Prevomers of *Oreophryne atrigularis*, spec. nov. (ZMB 63291).

Fig. 7. Hyoid plate of *Oreophryne atrigularis*, spec. nov. Anterior process of processus posterolateralis is bifurcate in this older specimen (ZMB 63291) but has only a single process in the younger cleared specimen.

Fig. 8. Shoulder girdle of *Oreophryne atrigularis*, spec. nov. (ZMB 63291).

White: bones; stippled: cartilago.

**Osteology** (based on two cleared and double stained paratypes, ZMB 63291 and 63292): Otoccipitals (sensu Trueb 1973) broad and fused with frontoparietals, sutures well marked, frontoparietals paired, long and broad, with a very small interspace and covering most of the sphenethmoid; paired nasals somewhat broader than long, about one quarter as long as frontoparietals plus otoccipitals (Fig. 4); processus paraorbitalis of the nasal well developed and venterolaterally oriented. Each premaxillary with a strongly bent alar process (Fig. 5). Maxillary without teeth and only marginally overlapping premaxillary; ventral ramus of squamosal long, its zygomatic ramus very small and its otic ramus well developed; prevomers (sensu Trueb 1973) do not meet medially and nearly completely include the choanae (Fig. 6); pars lateralis of parasphenoid broad and long, pars medialis (cultriform process) long, nearly reaching posterior border of palatine bones; cartilaginous hyoid plate has large antero-lateral processes as well as bifurcate postero-lateral processes (Fig. 7), anterior process of postero-lateral process with bifurcate tip in the older specimen (ZMB 63291, see Fig. 7) but with a single tip in the younger one (ZMB 63292); hyalia without processes, postero-medial processes completely ossified, slightly bent and each showing a small postero-medial crista. Coracoids slightly angled, procoracoids cartilaginous, club-shaped and reaching laterally only to middle of coracoid, a thin rod-shaped, ossified clavicle is attached to the anterior margin of each procoracoid (Fig. 8). Sternum voluminous, ossosternum lacking, xiphisternum with two lateral lobes. In the obviously younger specimen (ZMB 63292) the sternum is mostly cartilaginous (only corpus sterni and manubrium sterni with a few bone substances). In the older specimen (ZMB 63291) corpus sterni and manubrium are completely ossified and only lateral lobes are cartilaginous. Both specimens show two other differences regarding ossification of bones: (1) in the younger specimen there is a cartilaginous "bridge" between coracoid and scapula, in the older this "bridge" is ossified and both bones seems to be fused to a single one; (2) anterior part of cleithrum is ossified in both specimens; the posterior part is ossified in the older specimen but is cartilaginous in the younger specimen. Terminal phalanges T-shaped, cross part (of





Fig. 9. Rainforest habitat of *Oreophryne atrigularis* in the Wondiwoi Mts., 550 m a.s.l.

the T) relatively short. Eight nonimbricate presacral vertebrae, the third one with broadest transverse processes, sacral diapophyses broadly expanded, urostyle with a weakly developed bifide crista on its dorsal anterior half, which becomes single-ridged posteriorly.

**Etymology.** The specific epithet refers to the colouration of the throat. Ater (atra, atrum) is a Latin adjective and means black, and gularis is also Latin and means “belonging to throat”.

**Distribution.** Known only from the type locality, the slopes and valleys between 350 and 750 m a.s.l. in the Wondiwoi Mountains west of the coastal village of Yeretuar, base of the Wandammen Peninsula, Irian Jaya.

**Habitat and habits.** *O. atrigularis* is one of the most abundant amphibians in the Wondiwoi Mountains. It lives in dense closed rain forest and in more open forest and the undergrowth varies from extremely sparse to areas with many shrubs, grasses and herbs (Fig. 9). Frogs were found on steep slopes, and also at the bottom of valleys and gorges, often long distances from water. At night males perched on leaves between 0.5 m and 2.5 m high. They were spaced at least several metres apart and no more than one male occupied the same shrub. Some males started calling from beneath the leaf litter at dusk, and then climbed on to small shrubs where they continued calling during the night. This suggests that the litter is used as a diurnal retreat by this species. Calling activity was most intense between shortly after dark and 9 p.m., but single call series were heard throughout the night. Calling males were found in May, July and August; the site was not visited during any other month.

**Vocalization.** Advertisement calls consist of series of notes. Most series start with notes having long and irregular inter-note intervals (“slow” notes). During the call sequence note intervals become shorter and more regular (“fast” notes) (Fig. 10). There are calls with only a few introductory notes and long phases of fast notes, others have equal parts of slow and fast notes, and there are also calls with many introductory slow notes and only a few fast notes at the end. Most call series last 15 to 30 s and are separated from each other by intervals of at least 4 s (usually more). In 30 call series, the call components with short and regular intervals contained a mean of 17.7 notes (SD 7.83, range 6-30). Call series end abruptly during fast note sequences. Mean note length of 319 notes was 198 ms (SD 16.2),

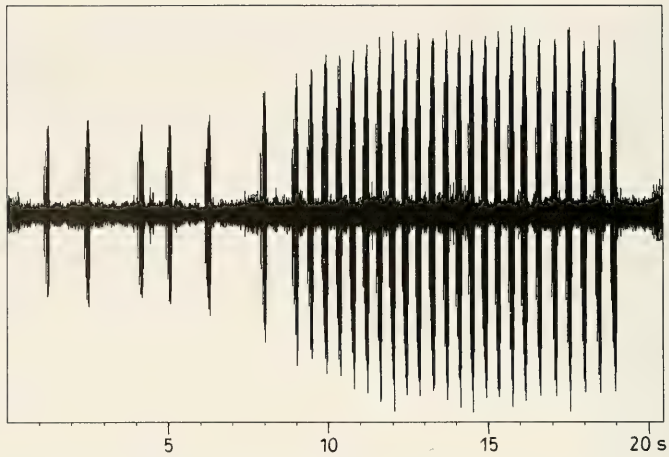


Fig. 10. Oscillogram of an advertisement call sequence of *Oreophryne atrigularis*. First six notes are of lower amplitude and the intervals between them are longer and irregular. These are followed by a sequence of 24 "fast" notes (see text). All recordings were made at temperatures between 22 and 24.5 °C.

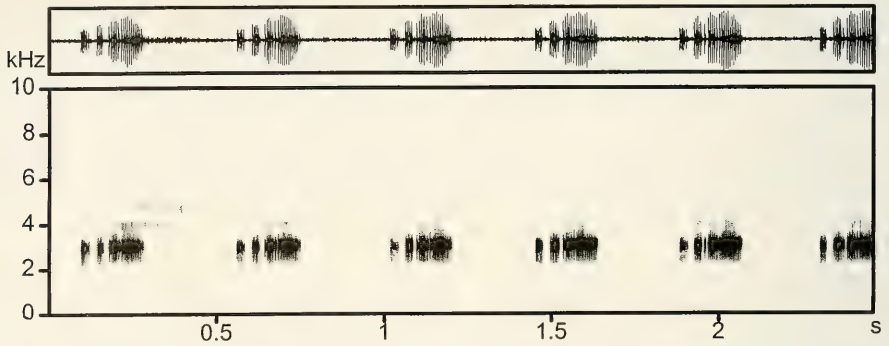


Fig. 11. Audiospectrogram (below) and oscillogram (above) of a series of six "fast" notes of *Oreophryne atrigularis*.

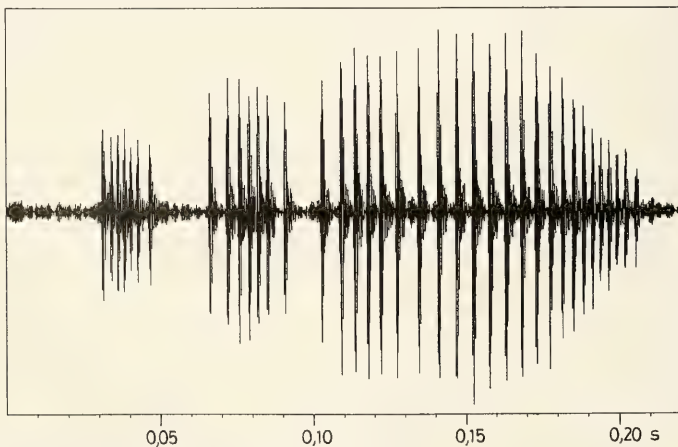


Fig. 12. Oscillogram of a single note of *Oreophryne atrigularis*.





Fig. 13. Frequency spectrum of one note of *Oreophryne atrigularis*.

minimum length was 171 ms and maximum duration was 262 ms. Inter-note intervals between 290 fast notes had a mean duration of 226 ms (SD 18.6), a minimum of 190 and a maximum of 312 ms. Mean repetition rate of fast notes was about 3/s. Harmonics and frequency modulations are not discernible (Fig. 11). Notes are composed of distinct pulses. Pulses are arranged into three groups which are separated from each other by short intervals (Figs 11 and 12). The first pulse group typically consists of 6-8 pulses, the second group contains also 6-8 pulses but of higher amplitude, and the third group has the longest duration and most pulses (15-25). Moreover, there is an amplitude modulation in the latter group. Fundamental frequency is about 1.5 kHz and dominant frequency is around 3 kHz (Fig. 13). All calls were recorded at temperatures between 22 and 24.5 °C.

**Comparison with other species.** *Oreophryne atrigularis* differs from all previously described *Oreophryne* in its possession of a protruding and sharply defined snout, and in the distinctive black coloration of the throat and lateral surfaces of the head. Described *Oreophryne* from New Guinea also differ from *O. atrigularis* in the following features: *Oreophryne anthonyi* (Boulenger, 1897), *O. idenburgensis* Zweifel, 1956 and *O. inornata* Zweifel, 1956 are easily distinguished from *atrigularis* by their much larger size (snout-urostyle lengths of more than 40 mm vs 26.3 mm). *Oreophryne albopunctata* (van Kampen, 1909) has webbed toes and much shorter hind limbs. *O. brachypus* (Werner, 1898) has quite different mating calls (Tyler 1967) and is known only from the Bismarck Archipelago. *O. brevicrus* Zweifel, 1956 has much shorter hind limbs, smaller terminal discs on the fingers and toes and is a terrestrial species. *O. crucifera* (van Kampen, 1913) has webbed toes, the 3rd and 5th toe are of equal length and the procoracoid reaches the scapula. We have examined specimens of *O. flava* Parker, 1934 from the AMNH and this species clearly differs from *O. atrigularis* in having the procoracoid reaching the scapula and the 5th toe longer than the 3rd. We have examined the type (SMF 4197) of *O. geislerorum* (Boettger, 1892) and it has very short tibiae (TL/SUL of the type 0.39) and basal webbing between the toes. We have examined specimens of *O. insulana* Zweifel, 1956 from the AMNH. It differs from *O. atrigularis* in having a rounded canthus rostralis, snout not protruding, 3rd and 5th toe of equal length, and basal toe webbing. In *O. kampeni* Parker, 1934 the procoracoid reaches the scapula and the toes are webbed. *O. parkeri* has a very distinct tympanum, its toes are webbed and its 5th toe is longer than the 3rd (Loveridge 1955). *O. wolterstorffi* was treated as a member of the Hylidae by Werner (1901) and subsequently transferred to the microhylid genus *Oreophryne* by Tyler (1964). We have examined one specimen (ZMB 16853) which differs from *atrigularis* in its distinct toe webbing, shorter tibiae, and 5th toe longer than the 3rd. The same suite of characters distinguishes *O. moluccensis* (Peters & Doria



Fig. 14. *Oreophryne wapoga*, spec. nov., paratype MZB. Amph. 7359; in dorsolateral view. This is the only specimen in the type series which has a longitudinal mid-dorsal line.



Fig. 15. Ventral view of *Oreophryne wapoga*, spec. nov., same specimen as in Fig. 14.





Fig. 16. Dorsal view of three paratypes and the holotype (second specimen from left in the top row) of *Oreophryne wapoga*, spec. nov. and of four paratypes of *Oreophryne atrigularis*, spec. nov. (bottom row). Visible numbers are field numbers.



Fig. 17. Ventral view of three paratypes and the holotype (second specimen from left in the top row) of *Oreophryne wapoga*, spec. nov. and of four paratypes of *Oreophryne atrigularis*, spec. nov. (bottom row).

1878), of which we examined types of its synonym *O. senckenbergiana* Boettger, 1895 (SMF 4203, lectotype; SMF 4204 and 4205, paralectotypes).

The types of *O. biroi* (originally described as *Sphenophryne biroi* by M ehely 1897) were stored at the Museum of Natural History in Budapest and are lost. According to H aupl et al. (1994) one syntype received in exchange from the Natural History Museum Budapest on 18.XI.1898 was deposited as NMW 19825 in the Naturhistorisches Museum in Wien. In fact, four specimens are catalogued under this number (NMW 19825: 1-4). From M ehely's papers (1897, 1901) it is clear that his original description was based on only two specimens with snout-vent lengths of 17 mm and 8.5 mm, collected near Friedrich-Wilhelmshafen (today Madang). In 1900 M ehely received various specimens from Sattelberg (about 250 km east of the type locality), the largest being 25 mm long, which he ascribed to *S. biroi*. It is extremely likely that the four specimens in the Vienna museum also originated from Sattelberg. Because M ehely himself regarded these specimens as belonging to *S. biroi*, they should serve as important material in future comparative studies (although they are certainly not syntypes of *Oreophryne biroi* and they are larger than the types from Friedrich-Wilhelmshafen). The SUL of these 4 now bleached specimens ranges from 20.6 to 22.5 mm and they are therefore similar in size to *O. atrigularis*. However, all have traces of webbing between the toes, their snouts are not protruding, TL/SUL ranges between 0.42-0.45, the 5th toe is longer than 3rd and M ehely did not mention a black loreal region and a blackish throat in his description of freshly preserved material. We have studied a syntype of *Mehelyia affinis* Wandolleck, 1911 (NMW 19826), which was regarded as a synonym of *O. biroi* by van Kampen (1923) and Parker (1934). There are sufficient differences between this syntype and the four *O. biroi* specimens to suggest that they represent different taxa, and the differences between this specimen and *O. atrigularis* are the same as those between *O. biroi* and *O. atrigularis*. This statement applies equally to other names regarded as synonyms of various *Oreophryne* species today. None of the species descriptions within the genus *Oreophryne* mention a black loreal and gular region, and a projecting snout with a well-marked canthus rostralis.

#### *Oreophryne wapoga*, spec. nov.

Figs 14-20

**Types.** **Holotype:** MZB Amph. 7358, adult male, collected by S.J. Richards and D. Iskandar on 11.IV.1998 at an altitude of 1070 m asl at Wapoga Alpha Exploration Camp (136°34'423"E, 3°08'687"S), Wapoga River headwaters, Irian Jaya, Indonesia. – **Paratypes:** Four adult males with inventory numbers ZMB 63435, SAMA R55923 and MZB Amph. 7359-60. All data as for holotype except that ZMB 63435 collected on 12.IV.1998, and SAMA R55923 collected on 16.IV.1998 by M. Moore.

**Diagnosis.** *Oreophryne wapoga* was not studied osteologically because of scarcity of material. However, superficial dissection of the pectoral girdle revealed the presence of reduced clavicles, demonstrating that this species belongs to the genus *Oreophryne*. Based on external morphology (Figs 14, 15) it appears to be closely related to *O. atrigularis*. Diagnostically important characters are the same as outlined for that species. From *O. atrigularis* it can be distinguished by a dark brown (not black) throat, a more spotted pigmentation, concealed parts of hind limbs are yellowish not red, a shorter head (HL/SUL 0.339-0.357), bigger eyes (ED/SUL 0.122-0.131), greater body size (males 21.8-23.3 mm SUL) and by different advertisement calls.

#### Description of the holotype

Measurements and ratios of body proportions are given in tables 2 and 3. General body shape same as for preceding species. Ground colour dorsally pale grey in fixative and beige in life, venter cream coloured. A solid black band extends from insertion of upper arm to tip of snout, bordered behind eye by a whitish stripe. Dorsum and head with irregular brownish marbling extending to tip of snout. Shape of the pupil oval, reddish-brown in life. Darker pigments concentrated dorsolaterally extend from eyes to middle of iliae. Flanks and dorsal surfaces of limbs covered with diffuse (not clearly marked and differing in size) brown spots. Posterior sides of thighs dusted with many very minute spots. All fingers and toes dark brownish above with exception of a whitish spot near base of terminal disk. Throat densely spotted, with irregular dark brown spots merging into each other. More isolated dark spots on chest and ventral sides of extremities, posterior of belly unspotted. Palms and soles greyish-brown, ventral side of fingers and toes inconspicuously spotted.





Fig. 18. Ventral view of right hand (left) and of right foot (right) of *Oreophryne wapoga*, spec. nov. (ZMB 63435).

**Variation in the type series.** Measurements and body proportions of the type series are given in table 2 and 3 and variation of coloration in comparison to that of *O. atrigularis* is shown on Figs 16 and 17. Coloration of preserved animals is very similar to that of living ones. One specimen MZB. Amph. 7359

Tab. 2. Measurements (in mm) of the type series (5 males) of *Oreophryne wapoga*.

Number	MZB. Amph. 7358	MZB. Amph. 7359	MZB. Amph. 7360	ZMB 63435	SAMA R55923
SUL	23.0	23.3	22.8	22.1	21.8
TL	11.8	11.9	11.7	11.8	10.7
TaL	7.8	7.7	7.7	7.1	6.6
L4T	11.0	10.9	10.6	10.6	9.5
L3T	8.1	8.0	7.8	8.0	7.6
T4D	1.3	1.3	1.1	1.2	1.0
F3D	1.4	1.3	1.3	1.2	1.1
HL	7.6	7.7	7.6	7.5	7.4
HW	7.8	7.9	7.8	7.7	7.9
L1T	1.8	2.1	1.9	1.8	2.0
LMT	1.3	1.2	1.1	1.0	1.1
END	2.0	2.4	2.4	2.1	2.1
IND	2.2	2.6	2.5	2.4	2.4
ED	2.8	3.0	2.8	2.9	2.7
TyD	0.8	0.8	0.7	0.7	0.9
FD	7.1	7.2	7.0	7.4	7.1

Tab. 3. Body proportions of the type series (n=5 males) of *Oreophryne wapoga*.

Ratio	Mean	SD	Range
TL/SUL	0.51	0.014	0.49-0.53
HL/SUL	0.334	0.0045	0.330-0.339
HW/SUL	0.345	0.0076	0.339-0.357
HL/HW	0.969	0.012	0.948-0.974
ED/SUL	0.126	0.0039	0.122-0.131
END/SUL	0.097	0.0072	0.087-0.105
F3D/SUL	0.0556	0.0038	0.0505-0.0608

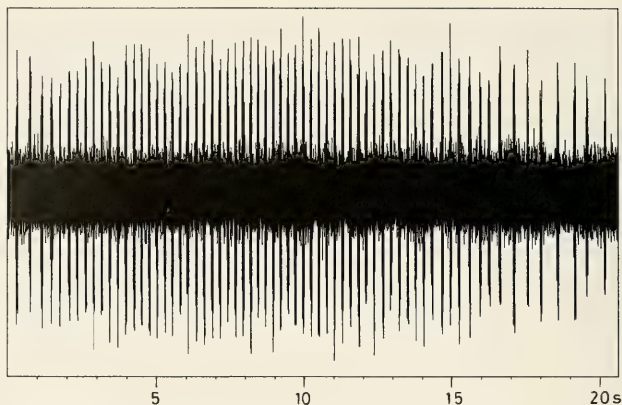


Fig. 19. Oscillogram of an advertisement call of *Oreophryne wapoga*. Notes at the beginning and at the end of the series are produced at a slower rate than the “fast” notes in the middle of the series.

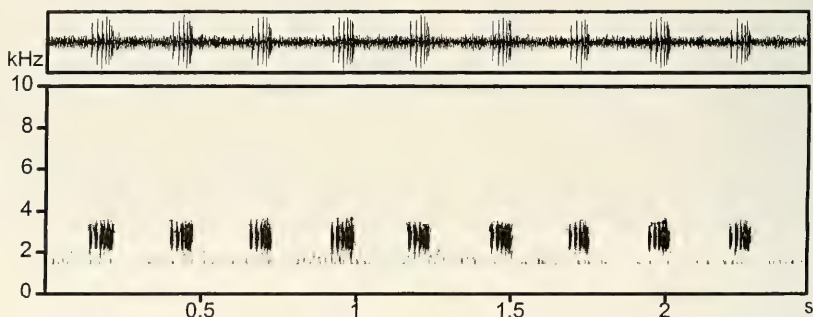


Fig. 20. Oscillogram (above) and audiospectrogram (below) of a sequence of nine “fast” notes of *Oreophryne wapoga*. Air temperature 20.6 °C.

has a relatively broad (in comparison to *O. atrigularis*) mid-dorsal line, bordered by irregular dark brown stripes. Remaining specimens lack a mid-dorsal line. Ground colour of dorsum grey in four specimens and brown in one specimen. Light dorsum bordered by an irregular dark longitudinal stripe dorsolaterally is typically for all specimens. Dorsal surface of head, body and limbs more or less spotted in all specimens, concealed parts of hind limbs yellowish and dusted with minute flecks. Flanks in four specimens lightly marbled below and more strongly marbled above; one specimen shows nearly uniform brown flanks. Small whitish spots or strokes are conspicuous on almost all penultimate phalanges near base of terminal disks. One specimen has a uni-coloured dark brown throat, others have some lighter regions within dark coloration. Chest and anterior of belly with more isolated brown spots, posterior of belly without or with only a few spots. Ventral surfaces of limbs more or less unspotted. One specimen with a cross-like figure on the chest. An inconspicuous w-shaped mark in the scapular region occurs in all specimens. Length of fingers and toes and size of terminal discs varies only a little, a “typical” state is shown on Fig. 18.

**Etymology.** Named for the Wapoga River headwaters where the type series was collected. Wapoga is considered as an invariable noun in apposition to the generic name.

**Distribution.** Known from the type locality in the Wapoga River headwaters, Irian Jaya, Indonesia. Based on morphology and structural features of vocalizations a population of frogs on Yapen Island appears to be closely allied to *Oreophryne wapoga* from the Wapoga River headwaters. We tentatively recognise this population as *O. wapoga* pending further studies (see below).





Fig. 21. Male of *Oreophryne cf. wapoga* from Yapen Island (ZMB 62625).

**Habitat and habits.** Male *Oreophryne wapoga* called from heights of between 1.0 and 2.5 m on leaves of understorey plants in lower-montane rainforest. All specimens were collected from a relatively dry ridge, and none were heard calling in the extremely moist gullies at the Wapoga site. Males called sporadically on clear, dry nights, and calling intensity increased during rain.

**Vocalization.** The advertisement call of *O. wapoga* has a similar basic structure to that of *O. atrigularis*; a long series of notes in which the initial notes of a call series have relatively long inter-note intervals followed by “fast” notes with much higher repetition rates. Note repetition rate of a call sequence may decrease again at the end of the call sequence (Fig. 19). Notes consist of 3-7 pulses, and terminal pulses are uttered at a higher rate than those at the beginning of the note (Fig. 20). 221 notes of two specimens were recorded at an air temperature of 20.6 °C. Their mean length is 76 ms (SD 11.9), minimum length 49 ms and maximum length 104 ms. 135 intervals between “fast” notes have a mean duration of 179 ms (SD 33.7), range 102-241 ms. Total call length varied from 10 to 31 s. The number of “fast” notes within 4 calls varies from 20-64. Fundamental frequency is around 1.5 kHz and dominant frequency is between 2.5 and 3 kHz. Repetition rate in sequences of “fast” notes was between 4 and 6 notes/s.

**Comparison with other species.** *O. wapoga* is morphologically similar to *O. atrigularis* and differs from other species of the genus in the same characters described in the “Comparison with other species” section for that taxon. The morphological similarity of the Wondiwoi and Wapoga populations initially led us to suspect that they might represent a single variable taxon. However, a number of consistent differences in morphology and call structure lead us to recognise the two populations as distinct species. The two taxa are of similar size although the SUL of *O. wapoga* is slightly and significantly greater (mean 22.6 mm) than that of *O. atrigularis* (mean 21.5 mm;  $t=3.5$ ,  $P=0.00081$ ). The head of *O. wapoga* is longer than that of *O. atrigularis*; HL/SUL of the former 0.330-0.339, of the latter 0.278-0.321,  $t=6.25$ ,  $P<0.0001$ ; HL/HW for *O. wapoga* 0.948-0.974, for *O. atrigularis* 0.735-0.888,  $t=9.08$ ,  $P<0.0001$ ; HW/SUL for *O. wapoga* 0.339-0.357, for *O. atrigularis* 0.333-0.404,  $t=3.96$ ,  $P=0.00024$ ; ED/SUL for *O. wapoga* 0.122-0.131, for *O. atrigularis* 0.102-0.120,  $t=6.30$ ,  $P<0.0001$ . Tibia length of *O. atrigularis* is slightly higher than that of *O. wapoga*;  $t=2.87$ ,  $P=0.0038$ .

There are consistent differences in coloration between the two species. Throat colour of *O. atrigularis* is uni-coloured black while that of *O. wapoga* is dark brown and speckled. Concealed parts of the hind limbs are red in *O. atrigularis*, without minute dark spots; those of *O. wapoga* are yellowish and dusted with fine specks. Notes within advertisement calls of *O. atrigularis* are much longer (171-

262 ms vs 49-104 ms in *O. wapoga*), have a complicated substructure showing 3 different pulse groups, and have a higher number of pulses (more than 20 vs 3-7 in *O. wapoga*). Internote intervals within fast note sequences have a duration of 190-312 ms in *O. atrigularis* and of 102-241 ms in *O. wapoga* ( $t=18.6$ ). As a result mean note repetition rate in the very fast note sequences was about 3/s in *O. atrigularis* and about 6/s in *O. wapoga* at a slightly lower temperature. The opposite trend would be expected if temperature was solely responsible for differences in note repetition rate. Sequences of fast notes in about 50 call series from *O. atrigularis* consisted nearly exclusively of less than 30 notes whereas 3 out of 4 series of fast notes in *O. wapoga* contained more than 30 notes, and two of these had more than 60 notes.

#### *Oreophryne* cf. *wapoga* on Yapen Island

Eight frogs collected by the senior author about 15 km north-east of Serui on Yapen Island closely resemble *O. wapoga* and we tentatively assign them to this species. However we exclude them from the type series because slight but consistent morphological differences raise some doubts about the relationships of the two populations. Two males (ZMB 62159 and 62160) were collected on 10 September 1999 and five males (ZMB 62622 and 62624-27) and one female (ZMB 62623) were collected on 18 and 19 May 2000 at an altitude of 610 to 630 m a.s.l. Selected body proportions are presented in table 4. Statistically the Yapen series differs significantly from *Wapoga* animals in the following characters: mean snout-urostyle length in *O. wapoga* males 22.6 mm, in Yapen males 20.9 mm ( $t=3.61$ ,  $P=0.0034$ ); mean ratio of head length/snout-urostyle length in *O. wapoga* 0.334, in frogs from Yapen 0.310 ( $t=3.77$ ,  $P=0.0030$ ); and mean ratio of head length/head width in *O. wapoga* 0.969 and in Yapen specimens 0.862 ( $t=4.09$ ,  $P=0.0017$ ). The only female from Yapen has a SUL of 22.5 mm and has large whitish and possibly immature ovarian oocytes that measure about 2 mm in diameter.

There are also differences in coloration between *O. wapoga* and *wapoga*-like frogs from Yapen. The blackish colour laterally on the head and on the throat is less intensive in most specimens from the Yapen population, and in two specimens (ZMB 62159 and 62160) is missing entirely. However the coloration of some frogs (for example ZMB 62622 and 62627) is remarkably similar to that of a paratype (ZMB 63435) of *O. wapoga*. None of the eight Yapen frogs has a whitish mid-dorsal longitudinal line (Fig. 21).

The advertisement calls of Yapen specimens consist of single creaks, small groups of creaks with comparatively long and often irregular inter-note intervals, and longer series of creaks. Notes consist of 4 to 5 clearly defined pulses (Fig 22). Longer call series often start with notes having long internote-intervals, and in the course of the series intervals become shorter and more regular. Longer series have a very similar structure and number of notes/s to those documented for *O. wapoga*. Some males called from under leaf litter and others called from shrubs at heights between 0.30 and 1.50 m.

Both colouration and advertisement call structure distinguish the Yapen Island population from *O. atrigularis*. Although differences in morphology and possibly in calling behaviour between *O. wapoga* from the type locality and *wapoga*-like frogs from Yapen Island doubtless exist, we believe that the data currently available do not support recognition of the Yapen population as a distinct species.

**Tab. 4.** Body proportions of a series of seven males and one female of *Oreophryne* cf. *wapoga* from Yapen Island.

Ratio	Mean	SD	Range
TL/SUL	0.53	0.019	0.48-0.53
HL/SUL	0.31	0.013	0.29-0.33
HW/SUL	0.36	0.018	0.34-0.39
HL/HW	0.86	0.057	0.74-0.93
ED/SUL	0.124	0.0052	0.116-0.132
END/SUL	0.095	0.0018	0.092-0.098
F3D/SUL	0.055	0.0049	0.047-0.060



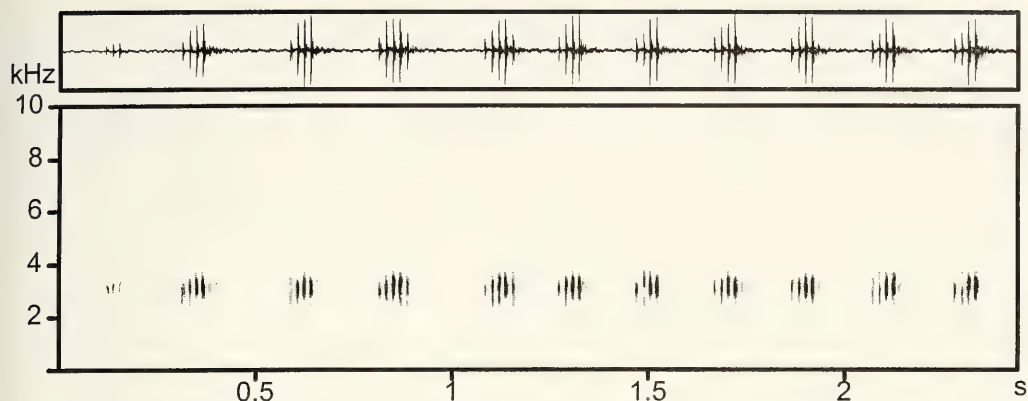


Fig. 22. Oscillogram (above) and audiospectrogram (below) of a sequence of 11 "fast" notes of *Oreophryne* cf. *wapoga* from Yapen Island. Air temperature during recording 22.5 °C.

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### References

- Boettger, O. 1892. Katalog der Batrachier-Sammlung im Museum der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt am Main. – Frankfurt a. M., Gebrüder Knauer, 73 pp.
- 1895. Liste der Reptilien und Batrachier der Insel Halmaheira nach den Sammlungen Prof. Dr. W. Kükenthal's. – Zool. Anz. 18: 129-138
- Boulenger, G. A. 1897. Descriptions of new lizards and frogs from Mount Victoria, Owen Stanley Range, New Guinea, collected by Mr. A. S. Anthony. – Ann. Mag. Nat. Hist., ser. 6, 19: 6-13
- Dingerkus, G. & L. D. Uhler 1977. Enzyme clearing of alcian blue stained whole small vertebrates for demonstration of cartilage. – Stain Technol. 52: 229-232
- Frost, D. R. (ed.) 1985 and 1998 (internet version). Amphibian species of the world: A taxonomic and geographic reference. – Allen Press and Assoc. Syst. Coll., Lawrence, Kansas, 732 pp.
- 1998-1999. Amphibian species of the world. Search the Amphibian Species of the World Database. Internet: <http://research.amnh.org/cgi-bin/herpetology/amphibia>. – The American Museum of Natural History, New York
- Häupl, M., F. Tiedemann & H. Grillitsch 1994. Kataloge der wissenschaftlichen Sammlungen des Naturhistorischen Museums in Wien. Vertebrata. – Katalog der Typen der Herpetologischen Sammlung nach dem Stand vom 1. Jänner 1994. Teil I: Amphibia (3): 5-42
- Kampen, P. N. van 1909. Die Amphibienfauna von Neu-Guinea, nach der Ausbeute der niederländischen Süd-Neu-Guinea-Expeditionen von 1904-1905 und 1907. – Nova Guinea, Résultats de l'expédition scientifique néerlandaise à la Nouvelle Guinée en 1907 sous les auspices du Dr. H. A. Lorentz 9: 31-49

- 1913. Amphibien, gesammelt von der niederländischen Süd-Neu-Guinea-Expedition von 1909-1910. – Nova Guinea, Résultats de l'expédition scientifique néerlandaise à la Nouvelle Guinée **9**: 453-465
- Loveridge, A. 1955. New frogs of the genera *Asterophrys* and *Oreophryne* from New Guinea. – Breviora **50**: 1-5
- Méhely, L. von 1897. Further contributions to the herpetology of New-Guinea. – Termész. Füzetek **20**: 398-419
- 1901. Beiträge zur Kenntnis der Engystomatiden von Neu-Guinea. – Termész. Füzetek **24**: 169-271
- Parker, H. W. 1934. A monograph of the frogs of the family Microhylidae. – London, British Museum (Natural History) 208pp.
- Peters, W. & G. Doria 1878. Catalogo dei rettili e dei batraci raccolti da O. Beccari, L. M. D'Albertis e A. A. Bruijn nella sotto-regione Austro-Malese. – Ann. Mis. Civ. Stor. Nat. Genova, ser. 1, **13**: 323-450
- Richards, S. & D. Iskandar 2000. A new minute *Oreophryne* (Anura: Microhylidae) from the mountains of Irian Jaya, Indonesia. – Raffles Bull. Zool. **48**(2): 257-262
- Trueb, L. 1973. Bones, Frogs, and Evolution. – In Evolutionary Biology of the Anurans, ed. Vial, J. L. Chapter 2: 65-132. Columbia, Missouri; Univ. Missouri Press
- Tyler, M. J. 1964. Systematic position of the New Guinea frog *Hylella wolterstorffi* Werner. – Rec. South Aust. Mus. **14**(4): 675-678
- 1967. Microhylid frogs of New Britain. – Trans. Roy. Soc. S. Aust. **91**: 187-190
- Wandolleck, B. 1911. Die Amphibien und Reptilien der papuanischen Ausbeute Dr. Schlaginhaufens. – Abh. Ber. Königl. Zool. Anthropol.-Ethnogr. Mus. Dresden **XIII**(6): 1-15
- Werner, F. 1898. Vorläufige Mittheilung über die von Herrn Prof. F. Dahl im Bismarckarchipel gesammelten Reptilien und Batrachier. – Zool. Anz. **21**: 552-556
- 1901. Über Reptilien und Batrachier aus Ecuador und Neu-Guinea. II. Reptilien und Batrachier aus Deutsch-Neu-Guinea. – Verh. Zool. bot. Ges. Wien **51**: 602-614
- Zweifel, R. G. 1956. Results of the Archbold Expeditions. No. 72. Microhylid Frogs from New Guinea, with Descriptions of New Species. – Amer. Mus. Nov. **1766**: 1-49
- & M. J. Tyler 1982. Amphibia of New Guinea. – In Gressitt, J. L. (ed); Biogeography and ecology of New Guinea. – Monogr. Biol. **42**: 759-801, Dr. W. Junk, The Hague